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METHOD FOR DETERMINATION OF SPECIFIC HEAT OF FOODGRAINS

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METHOD FOR DETERMINATION OF SPECIFIC HEAT OF FOODGRAINS

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Indian Standard

METHOD FOR DETERMINATION OF SPECIFIC HEAT OF FOODGRAINS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 7 November 1983, after the draft finalized by the Storage Structures and Storage Management Sectional Committee, had been approved by the Agricultural and Food Products Division Council.

0.2 Specific heat is the amount of heat required to raise the temperature of a unit mass of grain by 1°C. Specific heat of foodgrains is one of the important characteristics for designing the storage structures. The characteristic is also important for aeration, drying, milling, etc, of foodgrains.

0.3 Because of different methods used by agricultural scientists for its determination, it is not possible to have reproducible and repeatable values of the specific heat of various foodgrains. This standard, therefore, prescribes methods for determination of specific heat of foodgrains. Adoption of this standard would enable the compilation of data from all research workers on a uniform basis.

0.4 For the guidance of the design engineers, some of the observed values of specific heat are given in Appendix A.

0.5 In the preparation of this standard, considerable assistance has been drawn from the work carried at the Department of Processing and Agricultural Structures, College of Agricultural Engineering, Punjab Agricultural University, Ludhiana.

0.6 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes methods for the determination of specific heat of foodgrains.

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*Rules for rounding off numerical values (*revised*).

2. TEST SAMPLE

2.1 The foodgrain shall be properly cleaned so that it does not have refractions [*see* IS : 4333 (Part 1)-1977*] more than 0·5 percent. It shall be free from insect pests and micro-organisms.

2.2 The foodgrain shall be of the same variety.

2.3 The moisture content of the foodgrain shall be measured in accordance with IS : 4333 (Part 2)-1967† and stated in the test report.

3. PROCEDURE

3.0 Specific heat of the foodgrain may be determined by any of the two methods, namely, the calorimetric method and the indirect method.

3.1 Calorimetric Method

3.1.1 *Apparatus* — Calorimeter.

3.1.2 *Procedure* – Heat 30 g of foodgrain sample to a constant temperature (*Max* 66°C), avoiding over-heating which may alter the composition of the foodgrain. Fill the calorimeter cup with water of known temperature and dip the material in it. Stir the mixture well and note the final temperature, when it becomes steady.

3.1.3 *Calculation*

Specific heat of foodgrain,

$$\text{cal/(g. deg C) (} \textit{see} \text{ Note)} = \frac{(M_2 C_1 + M_3 C_2)(\Delta t_2 - \phi)}{M_1 (\Delta t_1 + \phi)}$$

where

M_1 = mass, in g, of the foodgrain sample;
M_2 = mass, in g, of the calorimeter cup;
M_3 = mass, in g, of water;
C_1 = specific heat of calorimeter cup in cal/(g. deg C);
C_2 = specific heat of water in cal/(g. deg C);
Δt_1 = temperature change of the sample in °C;
Δt_2 = temperature change of the calorimeter cup and water in °C; and
ϕ = temperature correction in °C.

NOTE — 1 Cal/(g. deg C) = 4 186·8 J/(kg. K).

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*Methods of analysis for foodgrains : Part 1 Refractions (*first revision*).

†Methods of analysis for foodgrains : Part 2 Moisture.

3.2 Indirect Method

3.2.1 The specific heat of a sample may be calculated from the known values of bulk density, thermal conductivity and thermal diffusivity for a particular variety of a crop at a specific moisture content by using the following equation:

$$C = \frac{K}{\rho\alpha}$$

where

C = Specific heat in cal/(g. deg C),
K = Thermal conductivity in cal/(cm. s. deg C),
ρ = Bulk density in g/cm^3, and
α = Thermal diffusivity in cm^2/s.

4. TEST REPORT

4.1 The test report should indicate all the characteristics of grain (*see* **2.1** and **2.3**) and whether the grain has been graded or not before determining its specific heat.

APPENDIX A

(*Clause* 0.4)

VALUES OF SPECIFIC HEAT OF DIFFERENT FOODGRAINS

A-1. VALUES BY CALORIMETRIC METHOD

A-1.1 Some of the observed values of specific heat for different varieties of groundnut and jowar are given below for guidance:

Sl No.	*Moisture Content, Percent*	*Specific Heat in cal/(g. deg C)*			
		Jowar		*Groundnut*	
		PSH-2 Variety	*Swarna Variety*	*A-K-12-24 Variety*	*SB-11 Variety*
i)	8	0·336 8	0·336 4	0·417 8	0·314 8
ii)	11	0·471 8	0·462 4	0·519 9	0·492 6
iii)	14	0·546 7	0·531 1	0·537 0	0·522 3
iv)	17	0·584 3	0·543 3	0·576 1	0·541 9
v)	20	0·597 0	0·591 3	0·597 1	0·593 6

A-2. VALUES OF INDIRECT METHOD

A-2.1 Some of the observed values of specific heat for important varieties of wheat, maize and paddy calculated by indirect method (*see* **3.2**) are given below for guidance:

Sl No.	*Foodgrain*	*Variety*	*Specific Heat in Cal/(g. deg C)*
i)	Wheat	WG-357	$0.325\,6 + 0.008\,2\,M$
		Kalyan-227	$0.333\,8 + 0.008\,725\,M$
		S-308	$0.303\,4 + 0.011\,125\,M$
ii)	Maize	Vijay	$0.360\,7 + 0.009\,239\,M$
		Local	$0{\cdot}290\,8 + 0.103\,8\,M$
iii)	Paddy	IR-8	$0.211\,0 + 0.011\,1\,M$
		Jaya	$0.244\,4 + 0.011\,47\,M$
		Jhona-349	$0.218\,0 + 0.011\,45\,M$
		Palman 579	$0.214\,8 + 0.010\,38\,M$

where

M = moisture content, percent on wet basis.